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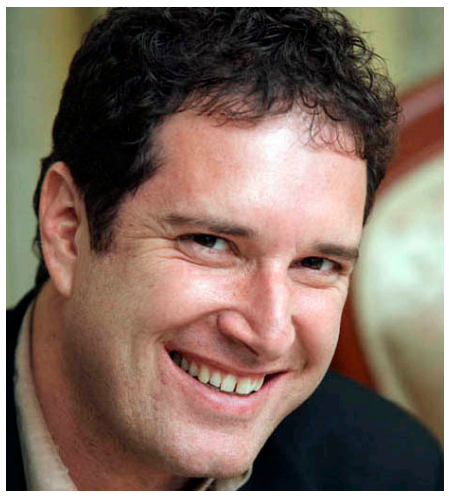
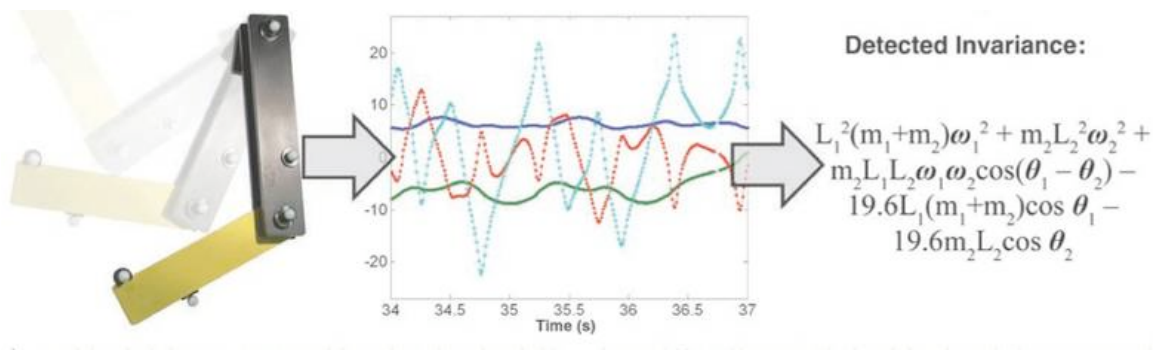
# Information Science and Technology Center Seminar



**Hod Lipson**
**Cornell University**

## "Distilling Free-Form Natural Laws from Experimental Data: From cognitive robotics to particle physics to computational biology"

**Wednesday, December 8, 2010**
**3:00 - 4:30 PM**
**TA-3, Bldg. 1690, Room 102 (CNLS Conference Room)**




**Abstract:** For centuries, scientists have attempted to identify and document analytical laws that underlie physical phenomena in nature. Despite the prevalence of computing power, the process of finding natural laws and their corresponding equations has resisted automation. A key challenge to finding analytic relations automatically is defining algorithmically what makes a correlation in observed data important and insightful. By seeking dynamical invariants and symmetries, we show how we can go from finding just predictive models to finding deeper conservation laws. We demonstrated this approach by automatically searching motion-tracking data captured from various physical systems, ranging from simple harmonic oscillators to chaotic double-pendula. Without any prior knowledge about physics, kinematics, or geometry, the algorithm discovered Hamiltonians, Lagrangians, and other laws of geometric and momentum conservation. The discovery rate accelerated as laws found for simpler systems were used to bootstrap explanations for more complex systems, gradually uncovering the "alphabet" used to describe those systems. Application to modeling physical and biological systems will be shown.

Schmidt M., Lipson H. (2009) "Distilling Free-Form Natural Laws from Experimental Data," *Science*, Vol. 324, no. 5923, pp. 81 - 85. Try it on your own data.

**Biography:** Hod Lipson is an Associate Professor of Mechanical & Aerospace Engineering and Computing & Information Science at Cornell University in Ithaca, NY. He directs the Computational Synthesis group, which focuses on novel ways for automatic design, fabrication and adaptation of virtual and physical machines. He has led work in areas such as evolutionary robotics, multi-material functional rapid prototyping, machine self-replication and programmable self-assembly. Lipson received his Ph.D. from the Technion - Israel Institute of Technology in 1998, and continued to a postdoc at Brandeis University and MIT. His research focuses primarily on biologically-inspired approaches, as they bring new ideas to engineering and new engineering insights into biology. For more information visit http://www.mae.cornell.edu/lipson.

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